Space Sanctuary

A Viable National Strategy

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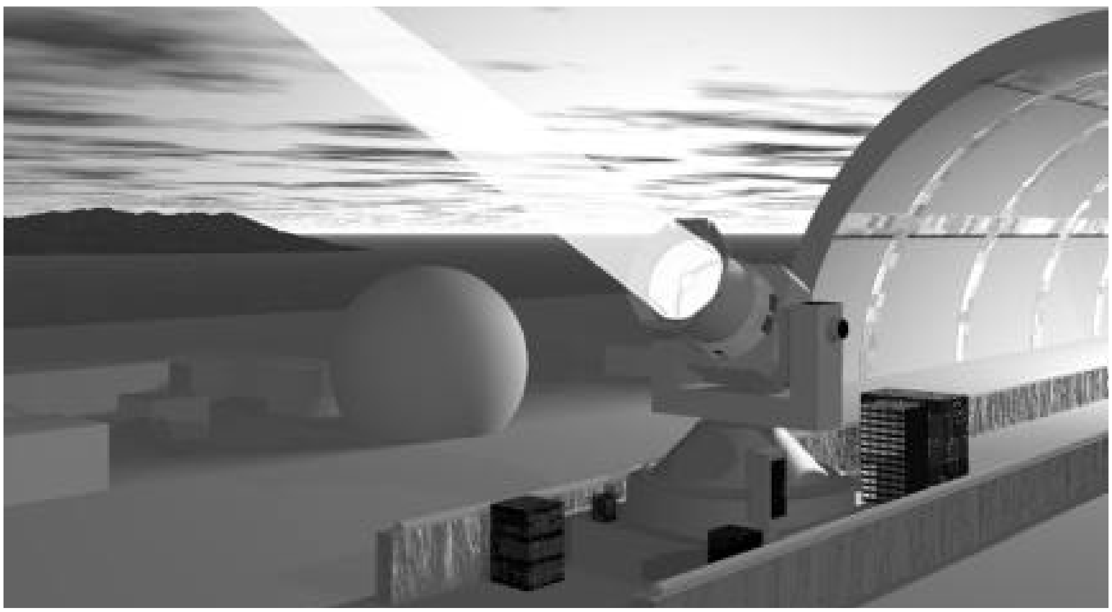

SPACE "militarization/weaponization" is not an "all-or-nothing" affair. For clarification, one can view military activities in space on a threat continuum (see table 1). As used here, *space weaponization* refers to anything greater than the current capability, which is roughly at the moderate threat level.[1]

Much of the literature flowing from the Department of Defense (DOD) on space and its role for future military operations makes a fundamental assumption: "Space will be weaponized; we only need to decide if the US will take the lead."[2] One cannot so readily make such an assumption. The immediate military advantages of being the first nation to weaponize space are undeniable[3] but must be weighed against long-term military costs, as well as against broader social, political, and economic costs. The decision to weaponize space does not lie within the military (seeking short-term military advantage in support of national security) but at the higher level of national policy (seeking long-term national security, economic well-being, and worldwide legitimacy of US constitutional values). At that level, many reasons suggest why the

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Table 1
Threat Continuum

THREAT LEVEL		MILITARY ACTIVITY
High	10	Space-to-Earth Weapons Capable
	7	Space-to-Space Weapons Capable
Moderate	5	Earth-to-Space Weapons Capable
Low	3	Space-to-Earth ISR/MCG/Comm[a]
	2	Space-to-Space ISR/MCG/Comm
	1	Earth-to-Space ISR/MCG/Comm

[a]ISR/MCG/Comm = intelligence, surveillance, and reconnaissance/mapping, charting, and geodesy/communications (military). Other less-threatening functions include missile warning, navigation, and environmental matters.

weaponization of space may not be the obvious "best" strategy.

The purpose of this article is to articulate those reasons. Space-sanctuary advocates will appreciate what follows as a comprehensive summary of their position; likewise, space-weaponization advocates will have to address these issues if their belief (that American preemptive weaponization of space best serves this nation) is to remain on firm ground. The following summary of the case against space weaponization proceeds from the *historical* trend of US nuclear and space policy to consider domestic and international *political* concerns. It then addresses the space-weaponization issue by briefly examining *adversarial* potential (the threat), *technological* limitations, *financial* trade-offs, *practical* considerations of military strategy, and the *emo*tional appeal of global security and well-being. This article is not meant to be an in-depth study of each facet of the debate; rather, it is a terse summary of the space-sanctuary argument aimed at opening the debate.

Historical Trend

Although the militarization of space may seem to be a new issue driven by emerging technological capacity, a historical trend dates from the close of World War II.

The Nuclear Weapons–Space Weapons Analogy

Demonstrations of atomic weapons at the close of World War II and the prospect of nuclear weapons married to emerging ballistic missile technology ushered in a new era of international relations. Threatening to use military force had always been an instrument of diplomacy, but the potential for instantaneous, indefensible, and complete annihilation posed a new rubric in the games nations play. Thus, nuclear deterrence was born.

Initial thoughts that such a threat relegated warfare to the shelves of history due to the prospects of massive nuclear retaliation proved naïve—subsequent lower-order conflict did not force nuclear escalation. Symmetric nuclear capabilities among the principal powers weakened the credibility of their use, while asymmetric responses (guerrilla and terrorist tactics, aligning with nuclear-capable parties, conflict protraction, etc.) still allowed lesser powers to test the resolve of the principals—particularly over issues of peripheral interest to those nuclear powers. Examples include Vietnam and Afghanistan. Visions of *massive space superiority* and the touted huge, coercive power advantage they provide will likely prove as bankrupt a notion as that of *massive nuclear retaliation*. In their logical evolution, both give way to strategies that recognize an international context of reactive nations. Principal powers will simply not allow a space hegemon to emerge, and lesser powers may concede hegemony but will continue to seek asymmetric counters.[4] The result will be a space strategy that better aligns with what evolved out of the nuclear dilemma: mutual assured destruction (MAD).

As a common MAD logic developed across the globe (but primarily between the two players in the game—the United States and Soviet Union), nontraditional foreign-policy traits became apparent. Any move toward developing weapons or practices that increased the viability of the idea that one could "win" a nuclear exchange was perceived as destabilizing. Deterrence in the form of MAD had to overcome the notion of "winning"—one that could come in several forms:

1. *A nation could survive nuclear attacks and prevail.* Conceding offensive dominance was critical if MAD were to deter nuclear holocaust. One had to avoid an odd array of destabilizing practices and systems, including missile-defense systems and civil-defense programs.
2. *A nation could use nuclear weapons on a small scale and prevail in a predominantly conventional conflict.* The term *theater nuclear weapons* was an oxymoron—every nuclear weapon was strategic because it posed the threat of escalation. Limited use of nuclear weapons was destabilizing; hence, one had to avoid any such strategy. Prohibiting the development of the neutron bomb, in spite of the immediate tactical benefits it offered to outnumbered NATO forces in Europe, was a direct result of this logic.
3. *A nation could launch a successful first strike*. Stabilizing approaches that reduced the viability of surprise via first strike were pursued. More than its name implies, if MAD were to prohibit a nuclear exchange, it had to be paired either with a reliable early warning capability allowing a reactive nuclear response or with a survivable second-strike capability. The United States pursued both: the former via space- and land-based early warning networks and the latter via submarine-launched ballistic missiles.

From this experience, one can draw and apply lessons as the possibility of space weapons emerges. Clearly, these weapons offer the potential for instantaneous and indefensible attack. Although the Outer Space Treaty of 1967 (outlawing weapons of mass destruction [WMD] in space) prohibits complete annihilation, the threat of annihilation would still exist—it is difficult to distinguish space-based WMD from space-based non-WMD. In simple terms, space weaponization could bring a new round of MAD.

Although MAD successfully deterred a nuclear exchange over the past 40 years, it was a very costly means of overcoming the lack of trust between superpowers. The dissolution of that distrust and the corresponding reduction of nuclear arms lie at the very heart of the Strategic Arms Reduction Treaties (START). Comparing the emergence of nuclear-tipped ICBMs with the accession of space weapons does yield some stark differences, however. There is no single threat to focus diplomatic efforts aimed at building trust, and there does seem to be some international support for the idea of coalescing a strategy supporting space sanctuary and deterring third world space upstarts. Aside from these differences, though, one could assume the existence of proliferated space weapons and proceed with the thought experiment that a space-MAD strategy would emerge among the principal powers. Again, one would have to eliminate the notion of "winning" a space-weapons exchange, and on at least the first two counts, one could do so:

1. It is logical to concede the offensive dominance of space-based weapons in low-earth orbit (LEO). Any point on earth could have a weapon pointed at it with clear line of sight; the potential of directed-energy weapons takes the notion of instantaneous to the extreme; and defense of every national asset from such an attack would prove next to impossible.
2. The same argument against the logic of "tactical" nuclear weapons would also apply to the "tactical" use of space-based weapons. Once they were used, any conflict could automatically escalate to a higher level.
3. The failing of a space-MAD strategy comes on the third count: early warning or survivable second-strike capability. Should space be weaponized and two space- capable foes emerge, there will be no 30-minute early warning window from which one actor could launch a counterattack prior to the impact of the preemptive first strike. Furthermore, space basing is equivalent to exposure—no strike capability can be reliably hidden or protected in space in order to allow a surviving, credible second strike.

Space-MAD weapons without early warning or reliable survivability logically instigate a first strike. This creates an incredibly unstable situation in which the viability of "winning" a space war exists and is predicated upon striking first (with plausible deniability exacerbating the problem), eliminating the "mutual" from MAD and only assuring the destruction of the less aggressive state. Obviously, this is *not* a good situation. Putting weapons in space could well be a self-fulfilling prophecy: we put them there because we anticipate we'll need them, and because they're there, we'll be compelled to use them; hence, we needed them.

The conclusion, then, of a nuclear weapons–space weapons analogy can only be that while the threats from each type of weapon are similar, the most successful strategy (MAD) for dealing with the former cannot work for the latter. Unlike the strategy for nuclear weapons, there exists no obvious strategy for employing space weapons that will enhance global stability. If the precedent of evading destabilizing situations is to continue—and that is compatible with a long history of US foreign policy—one ought to avoid space-based weapons. Further, even if one could construct a workable space-MAD strategy, the nuclear-MAD approach teaches that this is an intensely expensive means of dealing with mutual distrust between nations.

American Foreign Policy Tradition of Space Sanctuary

Forty years of cold war history show a successful pattern of US policy aimed at supporting space as a sanctuary. The reason is that we have more to lose if space is weaponized. Since the Eisenhower era, the open-skies philosophy has sought to bolster space ISR/MCG/Comm legitimacy—not space dominance. Theoretically, weaponization is overtly threatening and destabilizing, while a robust ISR environment—everyone spying on everyone—reduces paranoia and is ultimately stabilizing. This motivated the many signatories of the Outer Space Treaty of 1967 to agree that no proprietary claims could be made of space, thereby legitimizing global space reconnaissance.[5]

During the cold war, military spending strategies were clearly escalatory—when in doubt, buy more weapons. In spite of this general philosophy, though, some US restraint in weaponization occurred. The Carter administration thought better of deploying the neutron bomb, seeing it as an intermediate step between conventional and nuclear war and making the latter more likely. The logic of *not* pursuing a destabilizing weapon offers a tactical advantage. Had the Soviets fielded a tactical nuclear weapon, US response might have been different. The concept of space weapons took US restraint to another level. Although the United States pursued operational antisatellites (ASAT) on two occasions, they were reactions to Soviet moves toward operationalizing orbiting nuclear weapons and *not* a reflection of the prevailing trend away from ASAT deployment.

The first occasion came by order of the Kennedy administration (specifically, Secretary of Defense Robert S. McNamara) in May 1962. US Army Program 505 modified Nike Zeus antiballistic missiles (ABM) to accommodate nuclear warheads capable of destroying satellites in LEO. The second occasion, Program 437, followed soon thereafter. It too called for a ground-launched nuclear ASAT capability. Although both programs went operational in the spring of 1964, Program 505 was canceled within two years due to the longer range offered by Program 437. While these makeshift programs were in their infancy, information and sentiments were already emerging to halt them. Starfish Prime tests/studies of nuclear weapons in space made it clear that nuclear detonations in space were indiscriminate, capable of destroying adversarial and friendly capability alike.[6] Additionally, the use of Program 437 capability would violate the Partial Test Ban Treaty signed by the president in 1963.[7] The commitment to space-sanctuary strategy became clear as interest in and funding for Program 437 waned. The program was finally canceled in 1975.[8]

Other ASAT programs have appeared since, such as the F-15-launched Miniature Homing Vehicle, but congressional test restrictions as well as budgetary limitations have killed these programs well before they became operational.[9] This occurred in spite of the fact that the Soviets began testing a co-orbital ASAT in 1967 and maintained it as an operational ASAT through the end of the cold war. Even when provoked, the United States has shaped its strategy to maintain space as a sanctuary in order to protect the legitimacy of space ISR as well as the quality advantage of US space ISR/MCG/Comm capability.

Dwight D. Eisenhower. As president, he promulgated the "open skies" philosophy.

The United States has proceeded with this logic over four decades, producing, by far, the most capable of all ISR/MCG/Comm space infrastructures. The quality advantage of US ISR/MCG/Comm space capability still exists, and given waning Russian investment in its space program, one can make a strong case that the advantage is greater than it ever was during the cold war. The roots of this strategy are logically founded in the inherent, destabilizing nature of weaponization as opposed to the inherent, stabilizing effects of ISR. Simply put, in a relationship of mutual distrust, constant and assured surveillance is far more likely to avoid conflict than is the presence of offensive weapons. US pursuit of space sanctuary is more relevant today than it was in the past. In addition to destroying the legitimacy and security of our own ISR/MCG/Comm advantage, a policy move toward weaponization would be perceived domestically and internationally as a discontinuity of American national strategy—a destabilizing situation in itself.

Political Concerns

Aside from this historical pattern, there are numerous values, policies, and legal issues that directly support a space-sanctuary posture.

Incompatibility with US Constitutional Values

The United States exports its national values of individual freedoms and democracy and maintains a pattern of not bullying other nations into accepting these ideals. The expectation is that the inherent worth of the ideals is self-evident. Maintaining the moral high-ground in order to support this pattern is essential, even if it requires the United States to take some risks. Historically, it has taken such risks. Not responding in kind to the operational Russian ASAT is one case. More recently, the United States signed the Chemical Weapons Convention (ratified in the US Senate in April 1997) even though Russia, Libya, and Iraq refused to sign.[10] Why give potential adversaries such a military advantage? The answer is reputation. The idea of putting weapons in space to dominate the globe is simply not compatible with who we are and what we represent as Americans.[11]

No Political Will

Almost every military theorist from Carl von Clausewitz to B. H. Liddell Hart recognizes that the legitimacy of a military institution is predicated upon its connection with its supporting political instrument. The US Constitution is not subtle in its support of this concept. The fact that there is absolutely no political will to weaponize space calls into question the relevance of any plans to do so. The current administration[12] has been clear on its position regarding space, as evidenced in the opening statement of President Clinton's national space policy: "The United States is committed to the exploration and use of outer space by all nations for peaceful purposes and for the benefit of all humanity."[13]

The second statement in that same policy allows for defense and intelligence-related activities in pursuit of national security, but the intent is clearly at odds with current military thrusts for defensive and *offensive* space systems. Actions of the current administration have been stronger than its predecessors toward maintaining space sanctuary. Even space-weapons research and development efforts short of operational employment, traditionally used to hedge against emerging threats, have been derailed and replaced by terrestrial-based systems.[14] This lack of American political will to weaponize space is both a result of and adds credence to the remainder of this space-sanctuary argument.

Treaty Limitations

There are few treaty limitations on the weaponization of space. Any survey of the Outer Space Treaty and other international space agreements yields but one conclusion: except for WMD and ABMs, no international prohibition on space weapons exists. What is not explicitly forbidden by international law is implicitly allowed; hence, the United States can, if it chooses, put conventional weapons in space. But a second-order look at the ramifications of treaty obligations and the way foreign nations interpret those obligations yields a different conclusion. For instance, both START treaties (US and Russian agreements to destroy thousands of nuclear weapons) are linked to compliance with the ABM Treaty of 1972,[15] and most space weapons have ABM capability. The Russians will perceive the pursuit of space weapons as the pursuit of ABMs. This would jeopardize the START treaties—a direction the United States obviously does not want to follow.

International Opinion

Furthermore, any move by the United States to weaponize space not only incites potential adversaries to follow suit but also is perceived as provocative by allies as well as adversaries. History is full of examples of the emergence of one military power instigating coalitions against it.[16] Make no mistake, the world is acutely attuned to US moves toward space:

> The world space community is confused as to the need for the US to develop space weaponry now, and is dismayed that the US is planning to test a high-powered laser against a satellite target [F. Ongaro, Headquarters European Space Agency].

> The policing of space is an international concern. . . . The international community will be very concerned if the US goes alone to solve problems that affect all space powers [Dr. H. Richarz and Dr. K. Schrogl, Headquarters *Deutsche Agentur für Rahmfahrt Angelegenheiten* (DARA–the German space agency)].

> It is obvious to educated Russians that Americans are subject to self-persuasion. Americans say they intervene to uphold democracy and peace, but Russians see some other objective, oil, uranium or bananas. Therefore what America should not do in space at the present time is any sort of anti-satellite activity. The Duma (Russian Parliament) banned the use of anti-satellite weapons after a heated debate. The Russian military and their political allies wanted to keep an ASAT program. The proposed test of the US MIRACL laser against a US satellite is at the center of a Russian controversy. . . . ASAT development should not be a unilateral US action; it should be an international effort when required. Almost all of the Earth's states have some space requirements, and will see any move by the US towards space superiority as threatening [Dr. M. Tarasenko, Russian Center for Arms Control, Energy, and Environmental Studies].[17]

Adversarial Potential

What disturbs most foreign powers regarding US space development is the clear absence of motive: there is virtually no threat to US space-ISR dominance.

No Current Major Threat

Some foreign ISR threat has existed for many years. As mentioned above, the calculus was accomplished, and the historical pattern of US policy decisions has supported the conclusions that the gains from our own space–ISR/MCG/Comm capability outweigh what we stand to lose from others' space–ISR/MCG/Comm capability. The best way to secure that advantage has been to pursue space sanctuary. Arguments that support weaponization often cite the emergence of foreign space-ISR capabilities; yet, the proliferation of worldwide space-ISR capability is stabilizing. Only aggressive nations—with something to hide—would take exception to being monitored. Additionally, concealment, communications and operations security, and deception are all means by which the United States can counter foreign space-ISR, if and when we so choose. In the event of conflict, active measures also include ISR and communications jamming and/or attacks against ground stations (the true vulnerability of any space architecture).

While foreign ISR capability is proliferating, one must perceive it as what it is, for the most part—a stabilizing global pattern of watchfulness. Besides, it is not simply a matter of what data one can access from space but, more importantly, what one can do with the data that is accessed. The United States is by no means surrendering its lead on data pro-cessing and exploitation. The fact that a third world actor has access to space reconnaissance data should not be alarming, since it must be weighed against the huge, coordinated intelligence infrastructure (tasking, collection, processing, exploitation, dissemination, and archives) possessed and being further developed by the United States. In short, one can use less provocative means than preemptive weaponization to deal with minor gains made on US access to space data. These minor gains on data access may simply be the price of peace.

Further claims of adversarial space weapons are simply unfounded. Military futures studies often cite predictions of foreign space-based particle beams and other such technologies,[18] but in reality they merely provide paranoid justification for US space programs. Reality speaks of a different future:

1. Russia is currently operating under its own unilateral ban on ASAT testing. In November of 1991, the Russians announced that their co-orbital ASAT was still operational. But 12 of 29 tests between 1968 and 1982 resulted in failure; the ASAT is limited to inclinations between 62 degrees and 66 degrees; and its maximum range is one thousand miles.[19] Additionally, any current, open-source account of the Russian economy will find it in financial crisis (to the detriment of space funding). Earlier this year, Yuri Koptev, director of the Russian Space Agency, commented that of 20 nations active in space research and satellite launches, Russian spending ranked 19th.[20]
2. Europe's combined space efforts are growing, but Europeans refuse even to consider collaborative efforts at theater ballistic missile defense because of the potential ASAT spinoff capabilities it might afford. Collectively, Europe is one of the strongest supporters of space sanctuary.[21]
3. Japan constitutionally prohibits offensive weapons. The Japanese also declined to participate in a cooperative agreement with the United States aimed at building theater missile defense.[22]
4. China is interested in space but has done nothing except persistently pursue collaboration with Europe and the United States.[23]

The overwhelming evidence suggests that, unprovoked, the rest of the world is simply *not* interested in space weaponization at this time.

Dealing with Minor Current and Future Threats

US passive defense plans continue to address limited ISR threats posed by potential adversaries. Space protection is a recognized priority within the US space community, which continues to examine vulnerabilities and protection of national space systems. One can divide the methods of passive defense into two distinct categories—fundamentally a game of hide-and-seek:

1. Effective *"hide":* methods and mechanisms of countering foreign ISR collection efforts against the United States.
2. Secure *"seek":* methods and mechanisms countering attacks against US ISR collection efforts.

These will be discussed shortly. The point to be made here is that the space-weaponization advocate's conception of either defending space assets with space weapons or not defending them at all is a *false dilemma*. There are at least three viable approaches for defending US space assets: (1) diplomatic/political defenses (agreements aimed at building collective security), (2) passive defenses (hide-and-seek), and (3) active defenses (weapons). This article suggests that the more prudent option is a combination of the first two and active, aggressive avoidance of the third.

No "Pop-Up" Future Threat

To hedge against strategic surprise (a pop-up space-weapons-capable adversary), enhanced efforts at space-sanctuary treaty building offer several benefits. Beyond assurances that signatories are willing to abide, preestablished coalitions against any nation fielding space weapons would be a strong deterrent, greatly reducing the likelihood of an emerging threat. Furthermore, intelligence coordination across the coalition would provide a strong resource for monitoring the development of space weapons worldwide. If one can foster the appropriate international climate, it would be highly unlikely that space-weapons-capable rogue actors would pop up overnight.

Technological Limitations: An Overstated, Promised Capability

Much of the space-weaponization argument hinges upon an assumed capability, given proper investment. Such "technological optimism" warrants a second look. As noted by a distinguished scientist, "Scientists and engineers now know how to build a station in space that would circle the Earth 1,075 miles up. . . . Within the next 10 or 15 years, the Earth will have a new companion in the skies, a man-made satellite that could be either the greatest force for peace ever devised, or one of the most terrible weapons of war—depending on who makes and controls it."[24]

Surprisingly, the distinguished scientist is the father of the space rocket, Wernher von Braun, and the year he made this unrealized statement was 1952. More recently, space-shuttle design plans of the 1970s called for 160-hour turnaround times and a minimal-maintenance concept requiring three or four technicians.[25] Obviously, we have not attained anything close to this vision either. Such optimistic projections on the future uses of space have been around since the beginning of the US space program, and that tradition continues today. We should remain cautious on several counts:

1. The energy differential between air flight and spaceflight is orders of magnitude,[26] and requires not simply an evolutionary advance of current aerodynamics technology but revolutionary leaps in astrodynamics and rocket technology.
2. In the concept-design phase of many space systems, some aspects of the hostile space environment have underestimated effects. Micrometeorites, space debris, extreme temperatures, and excessive radiation all require shielding, insulation, and energy-dissipation mechanisms.
3. One of the biggest technical problems facing any spacecraft is generating and/or maintaining sufficient onboard energy.
4. Remote guidance and control of spacecraft have posed confounding problems since the advent of the rocket in the early 1940s.[27]
5. The growing global interconnectedness will blur the distinction between who owns what and for what purpose the asset exists. Assumptions regarding the isolation of adversarial space assets, along with assumptions regarding the capability to discriminately target those assets without collateral effects, have not been thoroughly examined.
6. Finally, technical capabilities as seen from the military perspective are typically measured against an adversary's ability to counter them. But these capability measurements must not be confined to symmetric responses. Building a huge space-capability differential between itself and other states will not insure the United States a resultant huge coercion capability. Asymmetric response by opposing states is a natural tendency.

All told, the story of proliferated space access and exploitation in the near future is grossly exaggerated. Since the beginning of the space age, we have readily assumed away the very many technical and political difficulties associated with access to and movement in space. It is a natural thing to do—the skies were readily conquered; why not space? Visions of Buck Rogers "flying" through space reinforce the natural, albeit false, analogy between the conquest of air and space—hence the misnomer *spaceflight*. This optimism is part of our American heritage. Although it is a positive motivator of our inevitable move into space, it must not cloud rational decisions.

Financial Trade-Offs

Before any nation pursues a particular strategy, it must assess both the benefits and costs of doing so. Some of the costs of space weaponization have already been addressed in terms of American reputation and military trade-offs. Another aspect of cost comes in recognizing where the chosen path might lead.

Another Costly Arms Race

Once a nation embarks down the road to gain a huge asymmetric advantage, the natural tendency of others is to close that gap. An arms race tends to develop an inertia of its own and is difficult to turn off. Will this generation's legacy be to provide a constant threat of space weapons, just as the constant threat of nuclear weapons has diminished?

National Opportunity Costs

Still another part of the cost analysis must weigh opportunity costs: what else could have been purchased? The following are but a few of the broader trade-offs to consider:

1. Cancer research is currently funded at $2.6 billion per year, an amount equivalent to roughly 1 percent of the DOD budget, yet 555,000 Americans are dying each year from cancer.[28] That is 10 times the number of American lives lost over the entire course of the Vietnam conflict. One must trade off further medical efforts at attacking this problem with the purchase of future weapons that might work against an adversary that is as yet unknown. It prompts the question, Which war are we losing? Cancer research is only one of many such domestic programs that must compete for limited resources.
2. By the close of fiscal year 1997, the national debt was estimated to pass $5.5 trillion.[29] Can the United States afford to borrow more on its future to fund space weapons?
3. Particularly, is the investment of billions of dollars premature? Aside from the costs of building a space-capable weapon, lifting it to space today costs roughly $10,000/pound. What if the United States pays $10,000/pound to lift a space-weapons architecture only to find in the aftermath of a technical breakthrough that the rest of the world closes the gap at a cost of $100/pound?
4. Even in the absence of a technological breakthrough, Americans have a pattern of fronting the costs of research and development only to find other nations taking our technology and using it to our disadvantage (for example, US development of microelectronics in the 1960s and subsequent Japanese exploitation of that development).[30] Parasitic behavior of corporations and nations in regard to technological advance is well documented,[31] offering upstarts the "advantage of backwardness." Following this pattern, US investments in the research and development of space weapons could lead to the demise of US international prowess.

Space architects must recognize that although space-weaponization strategies seem appealing from a military perspective, the weighing in of opportunity costs favors the much cheaper and historically effective sanctuary strategy.

Simple Economics

More than being a lot cheaper than a space-weapons strategy, space-sanctuary strategy in practice has many advantages as it relates to global commerce. Space weapons are economically provocative because they can appear to threaten that commerce. During a conflict, distinguishing space friend from space foe would prove difficult since most nations do not overtly "flag" their satellites. Additionally, a number of satellites have many roles and are possessions of many nations. Discriminating impartial, commercial space assets from adversarial space assets will be problematic. Furthermore, even in the event that one can isolate adversarial space assets, the collateral effects of space debris[32] will be extremely difficult to control. One cannot posit the benefits of having space-weapons capability without logically thinking through all the ramifications of using them.

Given the multinational commercialization of space that is being pursued far more intensely than a weapons program could be, it is very doubtful that the political arm would ever authorize the use of space weapons even if the United States possessed them. Why, then, should we pursue a huge investment toward a suboptimal space-weapons strategy—while the better space-sanctuary strategy is overlooked? Probably because such a strategy comes across as a weak, "do-nothing" approach, something disdainful to American military leaders. On the contrary, though, actively pursuing space sanctuary does not need to be a "sit-on-your hands" approach to national strategy.

Practical Considerations

The US military strategist is trained to think beyond historical trends and current policy issues; he or she is trained to think worst-case scenarios and imminent threats to US national security. Military space strategy must also be examined with the scrutiny of this perspective.

A Flawed, Long-Term Military Strategy of Space Weaponization

Sound *military* reasons exist for *not* weaponizing space. For example,

1. *space-weaponization strategies lack the element of survivability.* Space systems will not survive if they are targeted. Military systems in space, like all others, follow well-established, fixed orbits (orbital transfers are energy- and cost-prohibitive). This leaves space systems exposed and vulnerable. As predominantly unmanned systems, they also require data link to a controller, leaving them vulnerable to interference in the electromagnetic (EM) spectrum. For instance, a nuclear explosion in space—with force and radiation not attenuated by the atmosphere—could negate the use of vast numbers of orbits. Or direct-ascent ASATs, constructed from modified cold war ICBMs, could disperse something as simple as sand in LEO, leaving anything passing through it (17,000 MPH @ 200 km) severely damaged or destroyed. Many futuristic war games are conducted throughout DOD each year, and the play of space systems has increased. One conclusion persists: the fight for space is first and fast, and many space systems do not survive. As space access matures, the survivability issue will become obvious. Nations will not rely on space systems for crisis situations—they will rely on terrestrial systems (perhaps redundant with more efficient but more vulnerable space counterparts). Hence, the value of space weapons to deny those space systems will be moot.
2. *space-weaponization strategies maintain a bogus "center of gravity."* A military theorist would recognize US space ISR/MCG/Comm assets as a vulnerable center of gravity (COG) since they are both critical to successful military operations and extremely vulnerable to adversarial attack, as noted above. But using space weapons to protect this vulnerability is a leap beyond prudence. Terrestrial-based and space-based ISR/MCG/Comm assets are assuredly a vulnerable COG, but their vulnerability is not a result of being in or related to space; rather, it is a result of a centralized architecture. Sound military judgment has often led military strategists to eliminate a COG's vulnerability rather than require them to protect it—in this instance, perhaps a distributed architecture. A more detailed discussion of alternative means of dealing with the security-of-assets issue follows shortly. Here, one need only note that it is accurate to assume that space ISR/MCG/Comm is a COG, but the claim that "space" is the COG is awry. "Centralization" of this ISR capability is the COG, and weapons to protect it

are not necessary. One can successfully protect current space ISR/MCG/Comm systems by both decentralizing and enhancing the sanctuary approach of the past 40-odd years.

3. *space-weaponization strategies are provocative*. Space weapons are inherently offensive, and dominant offensive weapons encourage preemption against them.[33] Hence, space weapons are militarily provocative and destabilizing.
4. *space-weaponization strategies are escalatory*. Space weapons, by their nature, are escalatory. Because they are remote, they offer plausible deniability; because they are typically unmanned, they are easier to use. As such, the use of space weapons blurs the distinction between peace and war. They are another ambiguous step on the slippery slope to escalation.
5. *space-weaponization strategies are militarily self-defeating*. A space arms race threatens to negate the overwhelming military advantages we now hold in space, as well as in the air, on land, or at sea. By proving the efficacy of space weapons, the United States may provide the international community with an asymmetric approach capable of offsetting current US global dominance.
6. *space-weaponization strategies are politically self-defeating*. Pursuing the military advantages of space weapons will inevitably incite military coalitions against the United States.
7. *space-weaponization strategies are not a panacea*. As mentioned, the anticipated advantages of massive space superiority will be neutralized by symmetric reactions of major powers and offset by asymmetric responses of lesser powers.
8. *space-weaponization strategies are expen*sive. There are significant long-term-opportunity costs within the military, particularly in these times of diminishing DOD budgets. One can meet the same requirements with cheaper alternatives, such as combat unmanned ae-rial vehicles (UAV).[34] Weaponizing space will necessarily come at the expense of satisfying documented military deficiencies (strategic-lift deficiencies and the C-17, air-superiority deficiencies and the F-22 or joint strike fighter, forward-basing deficiencies and carriers, ISR deficiencies and the next generation of ISR satellites,[35] etc.).
9. *space-weaponization strategies are a single-point solution*. What can be done with space weapons can also be done from the air, without the political baggage of weaponizing space.
10. *space-weaponization strategies are not the only solution*. Finally, the military notion of sanctuary—a place where one can posture forces and a place which, if attacked, necessarily changes the nature of the conflict—has a long history of successful use. Twentieth-century examples include Portugal as sanctuary for the Nationals during the Spanish Civil War (1936–39), China as sanctuary for the North Korean air force (1951–53), China and Cambodia as sanctuary for the North Vietnamese (1965–72), Lebanon as sanctuary for the Palestine Liberation Organization (1978–82), Pakistan as sanctuary for the Afghan rebels (1979–89), and space as sanctuary for US and Russian ISR assets (1965–97).

Military strategists need to pause and carefully consider the military attributes of the standing national space-sanctuary policy before dismissing it as a "head-in-the-sand" approach to future US military prowess. Not doing so raises the question, Whose head is in the sand?

A Viable Space-Sanctuary Strategy

The United States has a written national space policy. Unfortunately, it is weak and ambiguous. It sounds much like the traditional American position of pursuing space as a sanctuary but reserves the possibility of weaponization. What is America doing as a nation with regards to space? Fumbling around in an ad hoc manner is a fair characterization with which few people would argue. No one is "in charge"; and there is no clear vision of what the future should be, no unity of effort, and no clear path or strategy to get to that future.[36] The following recommendations remedy this situation and stem from the validity of the sanctuary argument presented here.

Who Is in Charge? Before structuring a national space strategy, we must address the issue of command (authority and responsibility to set strategy) and control (authority and responsibility to execute strategy). The broad impact of space access and the issues it raises clearly warrant top-level oversight. Because the executive powers of the president were established for just such circumstances, the president should be "in charge." Vested in that "charge" is both responsibility of providing vision and authority to set strategy to pursue that vision.

What Is the Vision? The president must produce and communicate a clear vision of where the future of the United States in space will be. John F. Kennedy's vision of an American man on the moon by the close of the 1960s best illustrates a president's ability to focus a nation toward national goals in space. The twenty-first-century vision should include the United States as world leader in a peaceful space environment characterized by both extensive, multinational, exploratory ventures and intense commercial endeavors.

What Is the Best Strategy for Pursuing That Vision? To pursue that vision, the president retains the power to set strategy. Based upon the argument presented above, the best strategy for getting to that vision is one of space sanctuary. As stated, this is not a do-nothing strategy. We need to undertake intense diplomatic efforts to convince a world of nations that space as a sanctuary for peaceful and cooperative coexistence and stability best serves all. Treaties must address exactly what constitutes a space weapon, commitments to not employ them, mechanisms of verification/policing, and assurances of punitive response for violations. A treaty with the clause "the positioning of any weapon in space or attacking any space platform will be considered an act of war against all signatories of this treaty" would provide formal and instant coalition (or collective security) against any actor seeking the weaponization of space and would be a natural extension of the Outer Space Treaty of 1967. Clearly, the United States has the opportunity and means to lead the diplomatic ventures, as well as the resources to lead in developing the methods and tools of verification[37] and punitive response.[38]

The question of securing US space capabilities remains. One can reconcile this "security of assets" issue by a variety of initiatives other than protective weapons. First, diplomatic efforts (agreements and treaties), as briefly outlined above, provide a measure of collective security. Second, strategic alternatives eliminate the vulnerability of this military COG. Space-based ISR/MCG/Comm assets, as well as all the peripheral components of that system, are clearly a vulnerable COG; but, as discussed previously, that vulnerability is not an inherent result of having spaceborne components. It is a result of choosing a centralized architecture. Methods to eliminate the COG rather than protect it with space-based weapons include

- ISR/MCG/Comm system redundancy: terrestrial and/or space-based, small, multiple components set in a decentralized, distributed architecture (much like switching networks in telecommunication systems, the security afforded here is self-redundancy);[39]
- ISR/MCG/Comm system reconstitution: a plan that overcomes the loss of some system-critical components by establishing a responsive reconstitution capability (UAV backups and/or responsive space lift);[40] and
- ISR/MCG/Comm system substitutes: substitute and/or redundant terrestrial systems (e.g., inertial navigation, ground communication networks,[41] UAVs,[42] etc.).

Third, passive hide-and-seek defenses provide a preemptive measure of security. Effective *hide* measures (denying foreign ISR collection efforts against the United States) include

- deception (ISR provides a view of actions, but intent can be either hidden or scripted);
- camouflage;
- security measures to deny access (e.g., communications and computer security, software gates and passwords, proper classification and protection methods, etc.); and
- encryption, so even if data of intelligence value is accessed, it is not useful.

Secure *seek* measures (countering attacks against US ISR collection efforts) include

- warning to include ISR and other verification measures—attacks have to be observed while they occur if they are to be countered or avoided;
- vigilance to include ISR and other verification measures—more importantly, the emergence of ASAT capability needs to be recognized well in advance if countermethods are to be in place if and when an attack occurs;
- restricted orbits—for instance, if an airborne direct-ascent ASAT capability emerges, moving assets from the more vulnerable LEO locales to the less vulnerable geostationary locales might be prudent, or if a ground-based-laser ASAT capability emerges, high-cost space assets may need to be kept in orbits that limit exposure to the ground-based location of the ASAT;
- shielding from a variety of EM pulses as well as shielding from physical debris;
- automatic shutdown of spaceborne ISR collectors once a harmful EM pulse is detected, coupled with retasking the collection mission to less vulnerable collectors as well as archiving the source and location of the harmful emitter;
- automatic frequency modulation to reduce possibility of data-link jamming/intercept;
- security measures aimed at protecting critical information regarding US space systems (frequencies, orbital parameters, capabilities, etc.); and
- defensive information operations to counter computer-virus attacks, software bombs, and so forth with restricted access, extensive and regular software operational test and evaluation (OT&E), passwords, gates, encryption, and so forth.

Fourth, and finally, preparedness (maintaining the technical ability to deploy coalition space weapons should the need arise and beginning with the lesser provocative earth-to-space weapons)[43] provides both an additional deterrent as well as a fail-safe measure of security.

To suggest that robust space weaponization is the essential means of providing security of US space ISR/MCG/Comm capability and denying similar foreign capability grossly overlooks the many alternatives that avoid much of the cost and political baggage of space weapons. More than simply choosing the sanctuary strategy, the president and his administration must aggressively pursue it, all the while clearly articulating the reasons behind the strategy and the ways of implementing it.

Where Is the Unity of Effort toward Executing the Strategy? The Departments of State, Defense, Transportation, Energy, and Commerce, as well as a variety of government agencies and offices, all have parochial interests in space. None of them could fairly arbitrate discrepancies and execute a comprehensive sanctuary strategy. As an example, one should consider once again the protection-of-assets issue. All communities agree that national ISR capability is vulnerable and requires a measure of protection—but who picks up the bill? Currently, no one does—little is done toward funding space protection. Organizations chartered to acquire and operate spaceborne intelligence-gathering systems see the protection of national assets under the jurisdiction of the Department of Defense, emphasis on *defense*. Contrarily, DOD claims that government organizations with a mission to provide space reconnaissance cannot reliably satisfy that mission without providing a means of securing the assets. Both are good arguments without an arbitrator. Clearly, these issues require resolution, or the United States will end up with a very capable space architecture that is lost in the first fray. An organizational construct that can arbitrate such issues to the best interests of the country is necessary; fortunately, the United States has several models and precedent for just such an organization. All space-related organizations—including the National Aeronautics and Space Administration (NASA), United States Space Command (USSPACECOM), and the National Reconnaissance Office (NRO)— should be restructured under one single institution: the Department of Space. This would provide the unity of effort required for such an ambitious national effort.

Emotional Appeal

In total, the issues raised here indicate that long-term military costs and the broader social, political, and economic costs associated with the United States leading the world in the weaponization of space outweigh the prospect of a short-term military advantage. Furthermore, pursuing a national space strategy on the assumption made at the outset—that "space will be weaponized; we only need to decide if the US will take the lead"—can be challenged on a more fundamental level. This assumption is ultimately founded on a belief that the nature of people—their historical tendency to wage war—cannot change. Contrarily, the social nature of people can change. One has only to compare today's global attitudes toward slavery with those of 150 years ago.

If we continue to assume that major global warfare between nations is inevitable and prepare for it accordingly, we condemn ourselves to that future. Doing so assumes determin-ism—that the future will happen and that we have to optimize our position in it. That assumption is not necessarily true and runs counter to the American spirit. The future is what we make it. Perhaps we need to spend a little less time creating weapons to protect ourselves in a future that we are destined to stumble into and a little more time building the future we would want to live in. More than challenging a flawed assumption, this article suggests a replacement—an assumption that is both more optimistic about the nature of people and one that resonates with the American spirit: "The United States will lead the world into space; we only need to decide where and how to go."

Conclusion

Many US military war games today begin with strikes against US space systems in the 2010 to 2020 time frame. Each war game addresses what to do about those strikes and, of course, concludes with the call for space weaponization. The more significant (but missing) issue is the examination of exactly what happened in the geopolitical environment from the present to 2010/2020 that allowed those strikes to occur, and raises the question, Could they have been prevented? This article offers a close-to-complete, albeit terse, listing of the historical, political, adversarial, technological, financial, practical, and emotional aspects of the sanctuary argument. It provides a framework for addressing such questions. It does not intend to close the argument on any of these counts; rather, it is specifically aimed at opening debate. Whether accepted or not, US long-range space strategy must deal with each of the issues generated by the space-sanctuary argument. Each count deserves much deeper work. Furthermore, if one is to consider a sanctuary strategy credible, one must take pains to think through its execution. This raises interesting questions regarding cooperation (diplomatic requirements), verification (intelligence requirements), and punishment (technological requirements). In the end, one would hope that serious thought on these issues would yield a US space strategy that both *today* continues the 40-year pursuit of a secure space environment and global stability, and *tomorrow* projects several paths for cooperatively using space to seek US national interests: long-term national security, economic well-being, and worldwide legitimacy of US constitutional values.

Notes

1. Space has been "militarized" for many years. Space intelligence, surveillance, and reconnaissance assets have supported the American war fighter since the 1960s, and the role of space from the Cuban missile crisis to the Gulf War is well documented. Space "weaponization," a matter of degree, has not proceeded nearly as far. Both the United States and former Soviet Union have periodically demonstrated antisatellite weapons that are Earth-to-space capable, and the current testing of a ground-based laser (MIRACL) against a satellite indicates that the United States is on the threshold of robust Earth-to-space weapons.

2. See, for instance, comments by Gen R. S. Dickman (DOD's space architect) to the Institute of Electrical and Electronic Engineers' 1997 Aerospace Conference: "The department [DOD] is posturing to think of space as a fourth medium for operations. But it won't be sufficient to just develop space systems that can observe friendly forces or an adversary's forces. It will also become necessary to protect those systems from hostile action—destruction, deception, disruption, and takeover." Cited in W. S. Scott, *Aviation Week & Space Technology,* 10 March 1997, 57. See also C. A. S. McKinley (Air Force Space Command strategy and policy analyst): "By the turn of the century, military, civil and commercial exploitation of space will be an international norm. . . . Space warriors need to move beyond the Cold War's spacecraft destruction-only focus and employ space superiority campaigns composed of active defensive and offensive counterspace operations." "Space Superiority: A Call to Space Warriors," *Space News,* 24–30 June 1996, 15. See also Gen Joseph W. Ashy (then commander in chief, United States Space Command): "The United States will . . . eventually fight from and into space." J. Heronema, "AF Space Chief Calls War in Space Inevitable," *Space News,* 12–18 August 1996, 4.

3. Undeniable, yes; ubiquitous, no.

4. *Space hegemon* in these terms implies a military advantage from space that obviates other forms of military power (in much the same way the United States had a nuclear hegemony for a brief period after World War II).

5. The Outer Space Treaty of 1967 states that international law applies beyond the atmosphere. The treaty reemphasized standing international laws (e.g., one sovereign state cannot threaten the territorial integrity or political independence of another—United Nations Charter, 1947) and initiated new space-related laws (e.g., free access to space and celestial bodies for peaceful intent, prohibitions on national appropriations of space or celestial bodies, and prohibitions on putting any WMDs in space or on celestial bodies).

6. Curtis Peebles, *Battle for Space* (New York: Beaufort Books, 1983), 83–92.

7. Paul B. Stares, *The Militarization of Space: U.S. Policy, 1945–1984* (Ithaca, N.Y.: Cornell University Press, 1985), 81.

8. Peebles, 94.

9. Curtis Peebles, *High Frontier: The U.S. Air Force and the Military Space Program* (Washington, D.C.: Air Force History and Museums Program, 1997), 67.

10. T. Zimmerman, "Chemical Weapons: Senate Skeptics Ratify a Treaty," *U.S. News & World Report,* 5 May 1997, 44.

11. One may make the case that world domination is not the reason for putting US weapons in space, but, true or not, other nations would perceive it as a US attempt at world domination. Weaker nations have a natural tendency to unite and oppose emerging hegemonies. This would pose a real threat to the United States and the ideals it represents.

12. Although the space-sanctuary argument cannot stand on the disposition of the current administration alone, and although some people outside the administration hold the counterview, the policies of the current administration reflect a historical pattern of US bipartisan foreign policy—an effective policy of space sanctuary.

13. National Space Policy, National Security Directive 30, Office of the White House Press Secretary, 19 September 1996; on-line, Internet, 1997, available from http://www1.whitehouse.gov/WH/EOP/OSTP/other/launchstfs.html.

14. Research into space-based concepts such as Brilliant Pebbles was replaced by terrestrial-based Patriot Advanced Capability, improved Aegis radar, and Theater High Altitude Area Defense systems. D. Mosher and R. Hall, "The Clinton Plan for Theater Missile Defenses: Costs and Alternatives," *Arms Control Today,* September 1994, 16.

15. The ABM Treaty prohibits development, testing, and deployment of any space-based system or component and limits the United States and Russia to a single terrestrial ABM site with a maximum of one hundred missiles. Alasdair W. M. McLean, *Western European Military Space Policy* (Aldershot, Hants, England: Dartmouth Publishing Company, 1992), 179.

16. Michael E. Brown, Sean M. Lynn-Jones, and Steven E. Miller, eds., *The Perils of Anarchy: Contemporary Realism and International Security* (Cambridge, Mass.: MIT Press, 1995), 238. See also Stephen M. Walt, *The Origins of Alliances* (Ithaca, N.Y.: Cornell University Press, 1987).

17. Headquarters USSPACECOM/J5X, trip report, "Space Power Theory Research Trip—Western Europe," 10 October 1997, 6, 7, 11. Gen Howell M. Estes III, commander of USSPACECOM, commissioned a small group of academics to produce a space power theory by summer of 1998—this trip report reflects research toward that end.

18. Many of the Air Force's latest futures studies expound upon the proliferating threat of new technologies: *SPACECAST 2020* (Maxwell AFB, Ala.: Air University, 1994); *New World Vistas: Air and Space Power for the 21st Century* (Washington, D.C.: Air Force Scientific Advisory Board, 1995); and *Air Force 2025* (Maxwell AFB, Ala.: Air University Press, 1996).

19. David E. Lupton, *On Space Warfare: A Space Power Doctrine* (Maxwell AFB, Ala.: Air University Press, 1988), 68–69.

20. N. Novichkov, "Russian Space Chief Voices Dire Warnings," *Aviation Week & Space Technology,* 6 January 1997, 26.

21. McLean, 119.

22. Joseph P. Keddell Jr., *The Politics of Defense in Japan: Managing Internal and External Pressures* (Armonk, N.Y.: M. E. Sharpe, 1993), xiii, 8.

23. C. Covault, "China Seeks Cooperation, Airs New Space Strategy," *Aviation Week & Space Technology,* 14 October 1996, 29.

24. W. von Braun, "Man Will Conquer Space Soon," *Collier's,* 22 March 1952. Another point worth noting is that in 1952 the

Van Allen radiation belts had yet to be discovered. Von Braun did not realize that the orbit at 1,075 miles would be a deadly position for any space colony. This emphasizes our lack of experience in space and the complications that will inevitably arise as space access comes to fruition.

25. A sixteen-hundred-hour shuttle turnaround time (10 times that of the initial design) is currently exceptional, and ground-based maintenance has become an elaborate effort requiring hundreds of scientists and technicians.

26. Scaling the thrust-to-(weight-to-orbit) ratio of the shuttle down or scaling the Atlas thrust-to-(weight-to-orbit) ratio up yields roughly 1.15 million pounds of thrust required to get an F-16-sized vehicle with reasonable payload to orbit. The General Electric F110-GE-129 engine in the F-16 produces 29,000 pounds of thrust at sea level—40 times less than the thrust required to get it to orbit. Of course, this is simply a notional energy comparison since the air-breathing thrust mechanisms of the F-16 would be totally incompatible with the space environment.

Calculation: The shuttle carries its empty weight of 105,000 kg and a maximum payload of 21,140 kg to LEO (204 km, 28.45°) and uses a total launch thrust of 7,781,400 pounds (6,600,000 pounds in the first two minutes contributed by the solid-rocket expendables and 1,181,400 pounds over the first eight minutes and 50 seconds by the orbiter main engines). An Atlas 2 can get 6,000 kg to a similar orbit with its 485,000 pounds of launch thrust. Andrew Wilson, *Jane's Space Directory* (Coulsdon, Surrey, United Kingdom: Jane's Information Group Ltd., 1995), 274.

Getting an empty-weight F-16 (11,300 kg) and a reasonable payload (3,700 kg) to the same location via a shuttle-type approach requires 15/105 the thrust of the shuttle—roughly 1.1 million pounds.

Getting an empty F-16 and reasonable payload to the same location using an Atlas-type approach requires 15/6 the thrust of the Atlas—roughly 1.2 million pounds.

27. Michael J. Neufeld, *The Rocket and the Reich: Peenemunde and the Coming of the Ballistic Missile Era* (New York: Free Press, 1995).

28. R. Rubin, "Special Report: The War on Cancer," *US News and World Report*, 5 February 1996, 54.

29. Council of Economic Advisors, *Economic Indicators* (Washington, D.C.: Government Printing Office, December 1996), 32.

30. Arthur J. Alexander, *Comparative Innovation in Japan and in the United States* (Santa Monica, Calif.: RAND Center for US-Japan Relations, August 1990).

31. Alexander Gerschenkron, *Economic Backwardness in Historical Perspective: A Book of Essays* (Cambridge, Mass.: Belknap Press of Harvard University Press, 1962), 5–11.

32. Space debris is a very serious problem. See Ross T. McNutt, *Orbiting Space Debris: Dangers, Measurement and Mitigation* (Hanscom AFB, Mass.: Phillips Laboratory Directorate of Geophysics, 1 June 1992).

Over seven thousand man-made objects larger than 10 cm and an estimated 30,000 to 70,000 smaller objects between 1 and 10 cm have been deposited into Earth orbit. Their extremely small size (10^{-5} grams) is offset by their incredible speeds (between 30 and 160 *thousand* MPH). In addition to these, the real problem may be the 10 billion objects in the .1 mm to 1 cm range, which we currently have no means of tracking. A $50,000 shuttle window replacement was required following shuttle mission STS-7. The damage resulted from a .2 mm paint-chip impact on a side window.

33. The US Congress Office of Technology Assessment claimed that "pre-emptive attack would be an attractive countermeasure to space-based ASAT weapons." Edward Reiss, *The Strategic Defense Initiative* (Cambridge, England: Cambridge University Press, 1992), 145.

34. "Unmanned Strike Next for Military," "US Industry Searches for Design Formulas," "Payload, Not Air Frame Drives UCAV Research," and "Navy Wants UCAVs for Carrier Use," *Aviation Week & Space Technology*, 2 June 1997, 46–55.

35. Space weapons could very well come at the expense of the systems the weapons are designed to protect. The National Reconnaissance Office is currently pursuing future architecture studies with cost as a principal constraint. It is no longer the cold war environment of "buy the best capability." Better, more capable ISR/MCG systems will be set aside due to expense, and less capable systems will be purchased. Rolling in the cost of space weapons to protect these systems will only worsen that situation.

36. When asked by Sen. Sam Nunn (D-Ga.), chairman of the Senate Armed Services Committee, "Are you in charge of space?" retired Air Force general Charles A. Horner, former commander in chief (CINC) of USSPACECOM, felt compelled to reply, "That depends." It depends because he is the one CINC who exercises little control over his own command. NASA, the Defense Information Systems Agency (DISA), the Ballistic Missile Defense Office (BMDO), the Central Intelligence Agency (CIA), the Central Imagery Office (CIO), the National Reconnaissance Office (NRO), the National Oceanographic and Atmospheric Administration (NOAA), the Department of Commerce, the Department of Transportation, the Department of the Interior, the National Science Foundation (NSF), and the White House Office of Science and Technology all intrude upon his budget, while many of the same organizations intrude upon his launch, on-orbit control, research and development, and acquisition authority. Air Force Association Special Report, *Facing Up to the Space Problem*, 1 November 1994.

37. Extensive investments in intelligence, surveillance, and reconnaissance assets would be necessary to fulfill worldwide verification requirements.

38. This includes the research, development, and production of ground-to-space ASATs specifically allowed by treaty in order to support an international space-policing effort.

39. The National Reconnaissance Office intends to reduce both the size and weight of its current satellites by more than 50 percent. "NRO Satellites to Shrink in Size, Technology Director Says," *Space Business News*, 19 February 1997, 18.

40. Orbital Space Sciences is currently under contract to NASA to produce a small, air-launched, reusable space vehicle—the X-34—while Lockheed Martin is under contract to produce a larger, single-stage space vehicle—the X-33. Prototypes are scheduled for testing in 1999. J. Anselmo, "X-34 Designs Locked In," *Aviation Week & Space Technology*, 2 June 1997, 33.

41. Fiber-optics networks are a growing technology. A single optic fiber exceeds the entire carrying capacity of current communication satellites. Gordon R. W. MacLean, "Will Fiber Optics Threaten Satellite Communications?" *Space Policy*, May 1995, 99.

42. High-altitude-endurance UAVs are nearing maturity. Communications packages are estimated to at least equal those of Defense Satellite Communication Systems, with dwell times ranging from 12 to 48 hours. See Defense Advanced Research Projects Agency (DARPA) Tactical Technology Office; on-line, Internet, available from http://www.arpa.mil/asto/hae.html; DARPA's "High Altitude Endurance UAV Concept of Operations," draft version 2.1, 10 February 1995, 1-1 through 1-6; Defense Airborne Reconnaissance Office (DARO) UAV Program Plan, April 1994; or any of the latest articles in the periodical *Unmanned Systems*.

43. The other historical trend in US space policy has been to hedge our sanctuary bets with investments in space-weapons research and development. Pursuing space-sanctuary policy does not preclude being prepared to do otherwise; in fact, one can make strong arguments that such preparedness encourages other actors to follow the sanctuary policy, since they could gain no advantage by challenging that policy.